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MASSACHUSETTS CENTERS OF EXCELLENCE

A STATE OF OPPORTUNITY

ex · cel · lence (ek´se-lens)n. 1.The state, quality or condition of excelling; superiority; pre-eminence. 2.A surpassing feature or virtue.

It is an impressive story of economic success. ■ In the last decade Massachusetts has created a climate of growth — extending to every corner of the Commonwealth — helping all its citizens. ■ Other states, other countries, look to Massachusetts for what its success can teach them, for the lessons that they have already learned.

Chief among them: how to capitalize on the state's most abundant indigenous resource. Lacking the "natural" resources on which other states rely, Massachusetts has learned how to make the most of its greatest strength: the ingenuity, intelligence, skill and resourcefulness of its people. ■ While others study and try to understand and emulate its recent past, Massachusetts looks to the future.

It will be even more competitive. ■ That competition — domestic and international — shall be met by continuing the development of the Commonwealth's sophisticated academic and research community and by strengthening the alliance between the public and private sectors.

The Massachusetts Centers of Excellence Corporation is at the forefront of these efforts, providing resources and support — serving as a catalyst to bring together the best minds from industry, academia and government to foster innovation and to lead the Commonwealth into the next century.

MASSACHUSETTS CENTERS OF EXCELLENCE

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MASSACHUSETTS CENTERS OF EXCELLENCE

"Part of the attraction of Massachusetts is the enormous intellectual strength in the area which means that everything that gets done gets done at a higher level. That's the way excellence is maintained." — David Baltimore, Director, Whitehead Institute, Cambridge, MA.

Today Massachusetts leads the nation in such areas as biotechnology, electronic publishing, artificial intelligence, fiber optics, photovoltaics, marine electronics, and polymer and other material sciences. ■ In hundreds of laboratories throughout the state, research now underway will result in new products that will create economic growth and opportunity while preserving and improving our quality of life. This research includes work on strains of frost-tolerant crops; safe alternatives to harmful chemical pesticides; marine systems to explore the ocean depths; implantable polymer "sacs" that time-release vital fluids such as insulin; and biological techniques for rendering some toxic wastes benign. ■ Innovation, the key to our continued economic viability, is the process that turns ideas such as these into tangible realities. It simply cannot happen without the timely synergism of creative individuals.

"The Massachusetts Centers of Excellence is now in place and working. It is already galvanizing interactions which might otherwise not occur, bringing academicians together with government and industry to work over the long haul." — Carol Reinisch, Chair, Department of Comparative Medicine, Tufts University School of Veterinary Medicine, Boston, MA.

Created in 1985 by Governor Michael S. Dukakis with the support of the Massachusetts Legislature, the Massachusetts Centers of Excellence Corporation is demonstrating how state government can effectively facilitate the process of innovation to maintain its competitive edge in emerging technologies. ■ MCEC is initially focusing on four new technologies: biotechnology, marine science, photovoltaics, and polymer science. Each of these technologies has a wide range of applications with economic potential and each has already established a strong academic or industrial reputation in Massachusetts. Together they offer a vision of economic growth based on industrial diversity.

"Massachusetts is offering not just a nice science game, but what is absolutely vital to industry's success. Centers of Excellence can take a different viewpoint from universities or industry, to look for connections that others might not see."
— Lawrence W. McKenna, Director, New Business Development, Monsanto Polymer Products Company, Springfield, MA.

The collaborative efforts can take many forms — joint R&D ventures and consortia, state venture capital funds, incubators and small business innovation research programs.

To guide the Centers of Excellence in nurturing the growth of these technologies, Governor Dukakis assembled five governing boards: a corporation board and one for each targeted technology. Each nine member board represents an equal collaborative commitment of the best talent from industry, academia and government. ■ These leaders are building a new science and technology infrastructure in Massachusetts by providing incentives for collaborative research and development and opening up important new lines of communication between industry and academia.

MASSACHUSETTS A STATE OF OPPORTUNITY

The rate of technological change is accelerating. Companies, if they are to survive, cannot be static. For smaller companies with no in-house R&D capabilities, this can be an insurmountable problem.

"These small companies don't have the capacity to do R&D. They can't support the overhead. The Centers of Excellence program will enable them to do research they wouldn't normally be able to do." — Gordon Lankton, President, Nypro, Inc., Clinton, MA.

Economic development is encouraged by responding to the needs of the private sector. ■ Through a competitive grants program, MCEC helps companies stay ahead of the competition by enabling them to design and conduct their own R&D projects in collaboration with partners from the academic community. MCEC acts as a clearinghouse and provides support to transform research ideas into realities.

Each technology board issues Requests for Proposals seeking projects with economic potential. Only joint proposals from companies with a university partner or partners are eligible for MCEC funding. Each proposal must include a match of funds from the participating partners. ■ By optimizing available resources for technology development and new technology transfer, these grants help companies leverage limited federal R&D funds.

"The Centers program has tremendous potential. The competition is getting stiff and we must work harder to leverage federal dollars — that kind of money [can help] make the difference between success and failure." — Anthony P. Graffeo, Manager, Battelle New England Research Laboratory, Duxbury, MA.

MCEC grants also place recipients in a strong position to compete for venture capital. MCEC is coordinating its efforts with state venture financing agencies — such as the Massachusetts Industrial Finance Agency, Massachusetts Technology Development Corporation and Massachusetts Product Development Corporation — to provide money for start-ups, business expansion and new product development.

"The main thing that attracts companies to Massachusetts is the nearness to the educational institutions. Students are graduating — the cream of the crop — [and] a higher than expected percentage remain in this area. Companies have found it worthwhile to locate around [these] university centers." — Gordon Lankton, President, Nypro, Inc., Clinton, MA.

Massachusetts' outstanding public and private universities play a pivotal role in the Centers of Excellence strategy. From this base, MCEC is building a statewide network of institutions of higher learning and innovative companies to accelerate the transfer of ideas into the marketplace. ■ These "centers without walls" are nurturing new technologies for emerging as well as traditional industries, both vital for sustained economic viability and international competitiveness.

"State government has a role in establishing the kind of climate where innovation can flourish. That is a very important role." — Joseph G. Wirth, Vice President/ General Manager, General Electric Plastics Group, Pittsfield, MA.

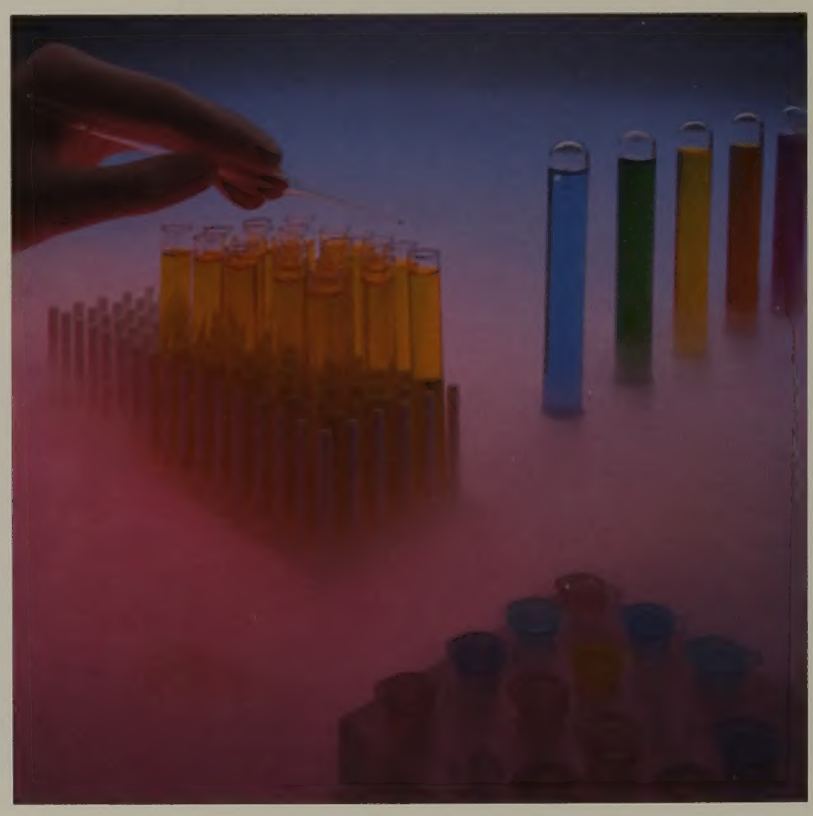
Biotechnology

"It is possible that biotechnology will change the industrial community of the future. It can produce unlimited quantities of products that are now in short supply, as well as commodities never before available. Production methods — using plentiful rather than scarce raw materials — can reduce cost and produce safer products." — Marc Goldberg, President, Massachusetts Biotechnology Council. ■ In Massachusetts many researchers in biotechnology labs are investigating environmentally safe pesticides, the prevention, diagnosis, and treatment of diseases and the biological degradation of hazardous waste materials. These new discoveries will play a prominent role in solving some of the world's most pressing problems of malnutrition, disease, and pollution.

"Massachusetts is an ideal location in the U.S. for biotechnology. The industry grew out of academia, with research done primarily at Harvard, MIT, Tufts and Brandeis. The successful companies today have a semi-academic, semi-industrial atmosphere. Although the technology is still in its infancy, it is clear that it does work. New products are on the market and there is a research pipeline bringing new products into many companies." — Gabriel Schmergel, President, Genetics Institute, Cambridge, MA. ■ It is precisely because of biotechnology's promise that there is such intense competition to commercialize its applications. The Biotechnology Center of Excellence is geared to support Massachusetts companies in commercial development and growth.

The MCEC competitive grants program initially focused on three areas of biotechnology applications that have considerable economic potential for Massachusetts: agricultural biotechnology, biomedical research, and toxic waste degradation and treatment.

Recognizing the tremendous potential in biotechnology research and manufacturing, the city of Worcester has taken the initiative with support from the Massachusetts Centers of Excellence Corporation to develop the Massachusetts Biotechnology Research Park. ■ This park will provide space for companies to locate and expand, while its incubator facility will support the development of small growing companies. Adjacent to the University of Massachusetts Medical Center and in close proximity to the Worcester Polytechnic Institute, the park is ideally situated to help promote interaction between biomedical science, engineering and industry. ■ "The Massachusetts government is very supportive of biotechnology and has already participated in legislative activities directed towards making biotechnology easier in Massachusetts. The activities of the Centers of Excellence, specifically the initiative to fund new projects . . . the quality of people . . . the universities . . . the infrastructure . . . companies already at the fore-front . . . the Massachusetts Biotechnology Council . . . That's why Massachusetts is a good place to be." — Nigel Webb, Damon Biotech, Needham, MA.



Biotechnology: Several commercially important plant species can now be cultured and regenerated in grow rooms, making it possible to produce plants of uniform size and quality.

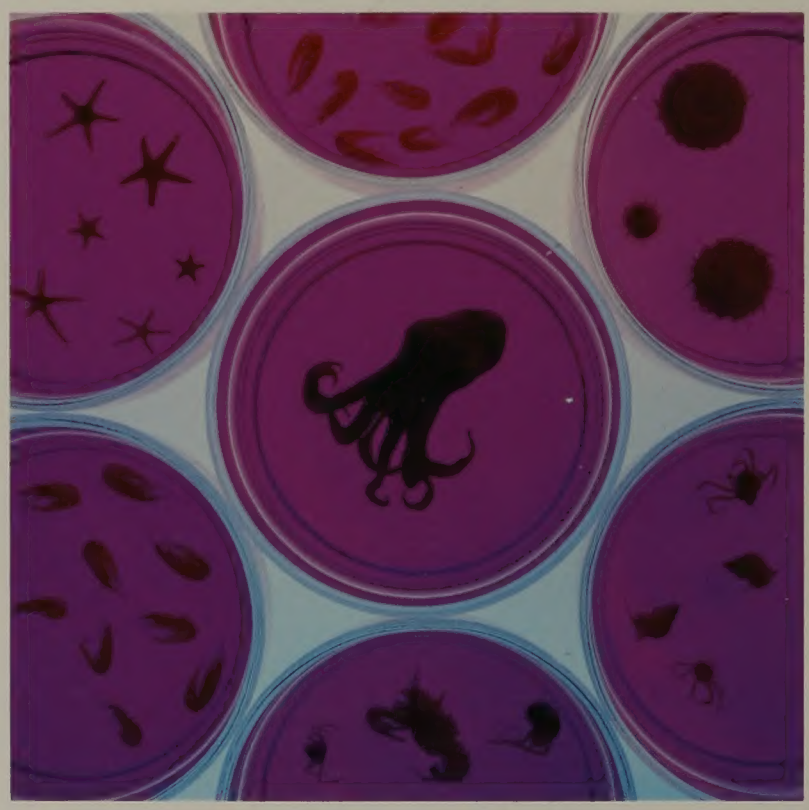
Marine Science

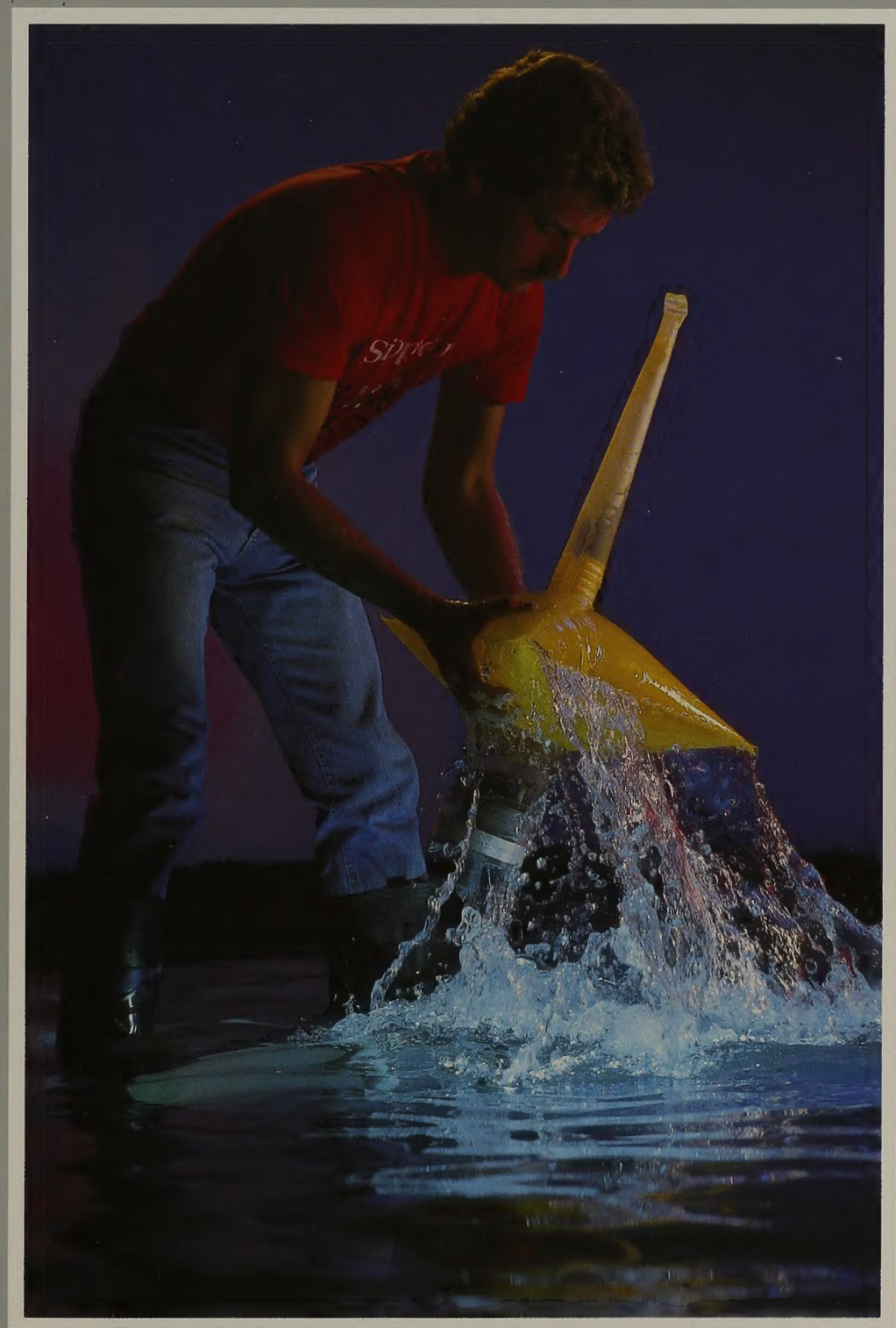
"Massachusetts is a great location for marine science explorations. We enjoy all of the Woods Hole, Southeastern Massachusetts University and Boston University resources. Take a look at what is here: Sippican, Datamarine, Raytheon and Neil Brown EG&G. Since the establishment of the Centers of Excellence, a dialogue between academia and business has begun that will ultimately lead to new ventures." — Richard Arthur, President, Sippican, Inc., Marion, MA. ■ Scientists predict that by the end of the century, applied ocean technology will furnish sizeable amounts of food, supply increased flows of minerals, provide vast energy components, and yield various medical products. ■ Today in Massachusetts companies working jointly with universities and research institutions have extended the frontiers of marine science. The *Titanic* exploration succeeded in part because it employed a camera developed by Benthos of Falmouth, MA that was carried by a robot developed at Woods Hole Oceanographic Institution.

These and other long-term business and research ventures in marine electronics, aquaculture, water quality engineering, and the fishing industry hold particular importance to Massachusetts' economic future. ■ "We are applying technology in the capture of fish, using gear that takes far less horsepower so the vessels can be lighter and smaller. The next area of innovation is in the holding of the product in the boat — it is in a refrigerated seawater solution with antioxidants, so that the fish in fact remain almost in the state that they were caught until they actually enter a factory." — John Todd, President, Ocean Arks International, Falmouth, MA.

The Woods Hole Oceanographic Institution, Southeastern Massachusetts University, the Massachusetts Maritime Academy, and Battelle New England Marine Research Laboratory, located in southeastern Massachusetts combine to create a unique concentration of marine research capabilities that can spur new technological development and business start-ups. ■ "Marine science companies have grown up here — spun off out of the universities. It's R&D, small company-oriented, government contracts. There is even a connection between biotechnology and marine science that the Centers will help us explore." — Anthony P. Graffeo, Manager, Battelle New England Marine Research Laboratory, Duxbury, MA.

The Centers of Excellence provides the impetus to expedite the commercialization of these joint business and academic efforts. ■ "I'm really excited about the Centers of Excellence. Businessmen think it is going to work. It is a marriage of industry and university and that's where everything has come from. There is a good feeling about this, and it is the right time when the private sector can step in and support state institutions." — Richard Arthur, President, Sippican, Inc., Marion, MA.





Marine Science: Electronics Technician testing the RF Transmitter of the AN/SSQ - 77A Vertical Line Array DIFAR (VLAD) Sonobuoy at Sippican, Inc., Marion, MA.

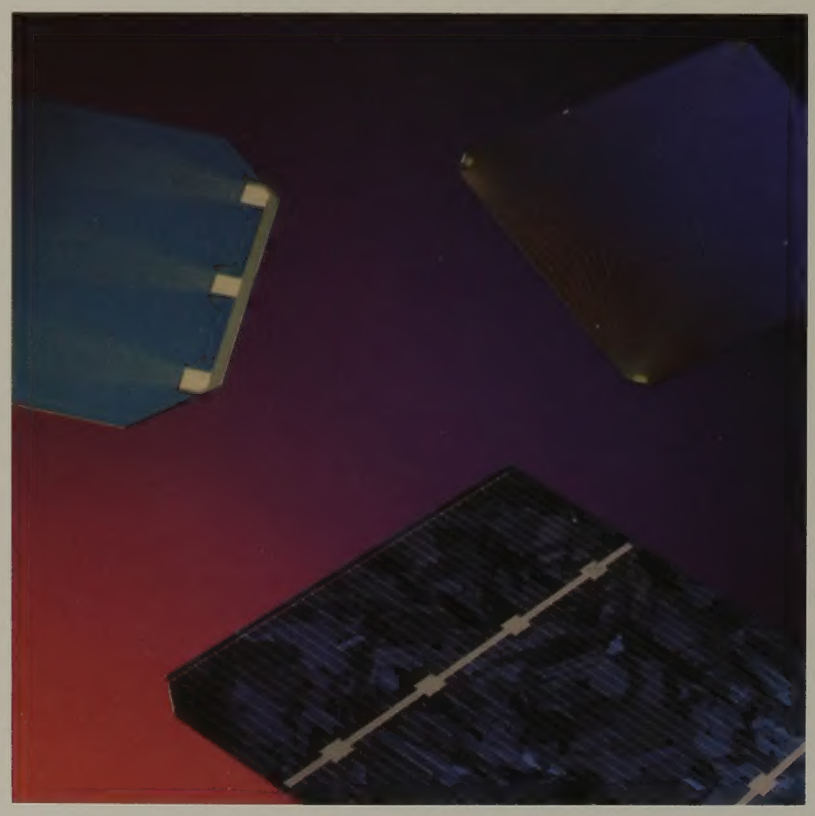
Photovoltaics

"Photovoltaics is the most exciting development in energy that we have seen in this century. It has the potential to provide a valuable source of energy to people throughout the world." — Ron Matlin, President, Chronar-TriSolar, Inc., Bedford, MA. ■

The Massachusetts Photovoltaic Center is a division of the Massachusetts Executive Office of Energy Resources. Conveniently located at Logan International Airport in Boston, MA., the Center promotes the use of photovoltaic technology (direct conversion of sunlight into electricity) in developing countries.

The value of photovoltaic (PV) devices lies in their ability to utilize free and renewable sunshine. Photovoltaic systems require no fuel, contain no fluids or gases, and produce no noise or pollutants. Photovoltaics can power any application requiring electricity. Current uses for PV systems include water pumping, refrigeration, and general electrification. These have proven to be most beneficial where conventional energy sources are impractical or simply not available. ■ "Photovoltaic technology has become a unique industry representing an enormous market. Massachusetts has the opportunity to contribute to the emergence of this technology on a worldwide basis." — Roger Little, President, Spire Corporation, Bedford, MA.

The opportunity to export to third world countries motivated the development of the Massachusetts Photovoltaic Center. An export marketing resource service provides Massachusetts photovoltaic companies with global market information identifying potential international customers. The Center provides both display and hands-on exhibits illustrating the fundamentals of this exciting technology and featuring round-the-world applications. ■ The Massachusetts Photovoltaic Center also offers a technology design service so that international customers can consult with professors and engineers from the University of Lowell and PV companies about photovoltaic applications, system installation, and maintenance. Training courses are designed and tailored to address the needs of a variety of international audiences. A financial information service assists in locating and arranging financing for photovoltaic projects.



"The strength and diversity of the photovoltaic industry in Massachusetts comes from such large corporations as Arthur D. Little, Polaroid, Mobil Solar, and Stone and Webster, combined with smaller firms such as Spire Corporation, Chronar TriSolar, and Crystal Systems. Individual companies have expertise in all stages of research, manufacturing, system design, and installation for utility-interactive or stand-alone applications." — Jane M. Weissman, Director, Massachusetts Photovoltaic Center, Boston, MA. ■

Photovoltaic technology has also proven ideal for adding generating capacity to U.S. utility companies. The cost of photovoltaics has been reduced tenfold during the past ten years, allowing it to compete with diesel generators for power at remote sites. Further research will make photovoltaics cost-effective for domestic use. ■ "The Centers of Excellence concept is important in a grand national sense. If the Massachusetts program is successful, it will cause the industry to grow at a sufficient rate to be able to do its own research (instead of relying on federal dollars) to move the photovoltaic technology into the 1990's." — Roger Little, President, Spire Corporation, Bedford, MA.

Photovoltaics: Technician operating the SPI - CONNECT T.M. 1,000 Solar Cell Connecting Machine, used to automatically interconnect individual solar cells into module circuits at Spire Corporation, Bedford, MA.

Polymer Science

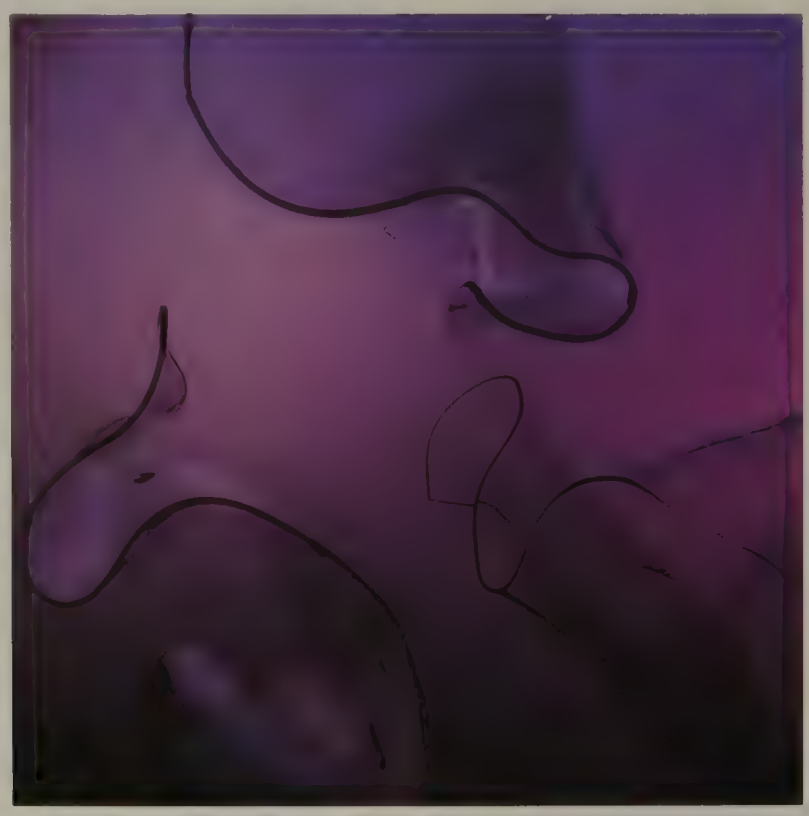
"The plastics processing industry employs more people in the U.S. than any other industry. And it is rapidly growing — at about twice the average of normal industries in the U.S." — Gordon Lankton, President, Nypro, Inc., Clinton, MA. ■ Polymers dominate today's materials industry. These high-performance resins have tremendous potential for replacing metals, glass, wood, and other materials including silicon in computer chips. In fact, more than 10,000 varieties of synthetic plastics are already in the marketplace, competing successfully in an increasing number of applications. Multilayer plastic ketchup bottles, soup cans, wheelchair wheels, injection-molded circuit boards, even car parts, boats, houses, airplane fuselages, and clothing are being made of polymers instead of traditional materials.

We now make use of more plastic than steel, glass, aluminum and copper combined. And because of rapid advances in technology, polymer applications are steadily expanding. By the early 1990's it is expected that the exterior of cars, now largely metal, will be almost entirely plastic. The reason: new plastic composites are delivering better performance at lower cost. ■ "Massachusetts can retain a lead in polymers by continuing to build on its strengths. The University of Massachusetts is the leading school of polymer science in the country. Certainly, one of the leading schools in the world. We fund research there, hire many people from there, and have visiting professors spend the summer at General Electric. We also have strong relationships with the University of Lowell and MIT." — Joseph G. Wirth, Vice President /General Manager, General Electric Plastics Group, Pittsfield, MA.

The significant presence of plastics firms in Massachusetts — ranking the state's industry among the top ten in the nation — combined with an internationally recognized polymer science research and development center at the University of Massachusetts, Amherst, positions the Commonwealth in the vanguard of its competitors. ■ Two of the major plastics producing companies, Monsanto and General Electric Plastics Group are located in western Massachusetts.

The Polymer Science Center of Excellence is playing a signficant role in maintaining this advantage by strengthening university and industry research, accelerating technology transfer of polymer research and manufacturing technologies to Massachusetts industry, and promoting excellence in education. ■ "The University of Lowell is the major source in the U.S. for developing plastics engineers. They are successful because they have combined the theoretical with practical, hands-on experience. They focus on reducing costs of materials now in production as well as new materials." — Gordon Lankton, President, Nypro, Inc., Clinton, MA.

The results are tangible. Today, a distinct new interaction is developing between the University of Massachusetts and the University of Lowell's polymer faculties and industrial polymer companies. Joint R&D projects are anticipated as a means of increasing the potential of commercialization of new polymer applications and processes. ■ "The Centers of Excellence brings together academia and industry to do common research that might not otherwise get started without it. It's the way outfits like Polaroid and Wang got going. If we can nucleate that sort of effort, we're really doing something significant. I think we can." — Richard Stein, Director, Polymer Research Institute, University of Massachusetts, Amherst, MA.



Polymer Science: Setting up at Impact Testing Laboratory at General Electric Plastics Technology Center, Pittsfield, MA.

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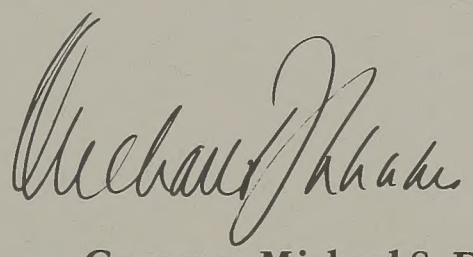
"Nothing is more important to the future of our state than a strong, growing, and healthy economy. In a new economic competition marked by innovation and the application of new technology we must make investment in new technologies a priority, a matter of the utmost importance to the future of our economy.

Here in Massachusetts we have a strong foundation on which to build that economic future.

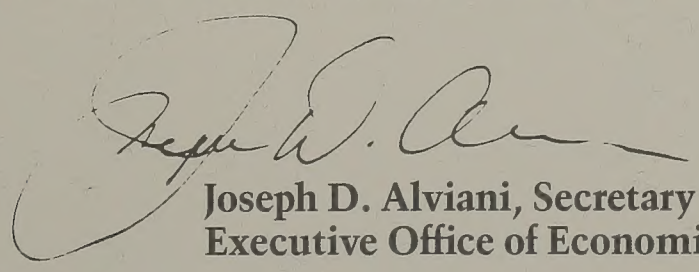
To meet this challenge, we have created a network of Centers of Excellence — to foster innovation at the cutting edge of science and technology, where cooperative research and development can help our industries compete in the global economy and continue to spawn new industries and new opportunities for jobs and economic growth."



Governor Michael S. Dukakis

"What makes the Centers of Excellence concept so exciting and innovative is the fact that it is the one agency mandated to focus on the future — a future based on a diverse economy of new technologies as well as traditional industries that are made more competitive by the application and transfer of these new technologies.

The Centers of Excellence will provide the citizens of Massachusetts with some measure of insurance against natural economic swings by supporting innovation as an ongoing activity. Our goal is to provide even the smallest of our innovative biotechnology, polymer, marine science, and photovoltaic companies with opportunities to engage in important and vitally needed research and development projects. In other words, to create "centers without walls."



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